



# Long-Term Surveillance Plan for the Decommissioned Hallam Nuclear Power Facility Hallam, Nebraska



U.S. Department  
of Energy

## Office of Legacy Management

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**Office of Legacy Management**

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**for the**

**Decommissioned Hallam Nuclear Power Facility**

**Hallam, Nebraska**

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Hallam, Nebraska**

**Revision History**

<b>Revision No.</b>	<b>Date</b>	<b>Description of Revision</b>
Revision 1	06/25/2008	Revised to reflect recommendations contained in "Summary of Ground water monitoring Results and Recommendation to Discontinue Monitoring at the Decommissioned Hallam Nuclear Power Facility, Hallam, Nebraska". June 2006.
Original	September 1998	

Approved:

\_\_\_\_\_  
Michele Miller  
Hallam Site Lead  
S.M. Stoller Corporation

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Date

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## **1.0 Introduction**

### **1.1 Purpose**

This Long-Term Surveillance Plan (LTSP) explains how the U.S. Department of Energy (DOE) Office of Legacy Management (LM) will fulfill its responsibilities as the long-term custodian of the Hallam Nuclear Power Facility (HNPF) at Hallam, Nebraska. The LM Program at the DOE-LM office in Grand Junction, Colorado, is responsible for the preparation, revision, and implementation of this LTSP, which specifies procedures for inspecting, monitoring, maintenance, reporting, and maintaining records pertaining to the site.

### **1.2 Legal and Regulatory Requirements**

The basis for radiological surveillance was previously established while a contract termination agreement was in effect that involved the Nebraska Public Power District (NPPD) and the U.S Atomic Energy Commission (AEC). The Chicago Operations Office of DOE and the Nebraska Department of Health (NDH) agreed to install a shallow groundwater monitoring system as part of the environmental surveillance program. Surveillance at the site was scheduled to end in fiscal year 2005, with no further activities planned afterwards. At that time the plan was to transition the site to the NPPD with future use of the facility to remain restricted. Since HNPF was owned by AEC (now DOE), DOE has title to and responsibility for the entombed radioactive materials (AEC 1971).

In compliance with the above agreement to end the environmental surveillance program at the site in 2005, DOE prepared a report in 2006, *Summary of Ground Water Monitoring Results and Recommendation to Discontinue Monitoring at the Decommissioned Hallam Nuclear Power Facility, Hallam, Nebraska* (DOE 2006), providing an assessment of groundwater monitoring results at the site since 1970 and through the June 2006 sampling event. This assessment indicated that there has been no impact on shallow perched groundwater in the immediate vicinity of the entombed reactor. Based on evaluation of hydrogeologic conditions in the vicinity of the site, there was no compelling evidence that there would be potential for impact to the shallow perched groundwater system or connected water resources in the future. Also, there was no use of shallow perched groundwater as a drinking water source near the site, and the area surrounding the site was restricted because of ownership by the NPPD. Consequently, there was no current or anticipated unacceptable risk to human health and the environment related to the decommissioned HNPF. Thus it was determined that monitoring of shallow groundwater to date had been effective in demonstrating no impact to the shallow perched groundwater 37 years after entombment of the reactor, which has met the objectives set forth between the parties.

Based on this assessment, no further groundwater monitoring activities were recommended or deemed necessary at the Hallam Decommissioned Reactor Site. DOE recommended that monitoring of shallow perched groundwater in the vicinity of site be discontinued and the monitor wells decommissioned. The State of Nebraska responded to this DOE report and recommendation indicating they did not concur with DOE recommendations but would accept reducing sampling and analysis frequency to once every 2 years (State of Nebraska 2007). Consequently DOE has accepted the State of Nebraska position, and the next sampling event at the Hallam Site will occur in June 2009 (DOE 2007a) (see Section 3.1.1). Analytical results from monitoring will be evaluated and reported every 2 years and decisions will be made, in

consultation with the State of Nebraska, regarding continued reductions in monitoring frequency and possibly monitoring points, and ultimately leading to an abandonment of groundwater monitoring altogether, based on continued demonstration of no impact to human health and the environment.

### **1.3 Role of the U.S. Department of Energy**

In 1988, DOE designated the Grand Junction facility as the program office for managing DOE sites that contain regulated low-level radioactive materials and portions of sites that do not have a DOE mission after cleanup, as well as other sites as assigned, and to establish a common office for the security, surveillance, monitoring, and maintenance of these sites. DOE established the Long-Term Surveillance and Maintenance Program to fulfill these responsibilities.

In December 2003, DOE formally established LM. The LM mission includes “...implementing long-term surveillance and maintenance projects at sites transferred to LM to ensure sustainable protection of human health and the environment.” LM is responsible for implementing this LTSP.

## **2.0 Site Background**

### **2.1 Description of Site Area**

#### **2.1.1 Location and Property Ownership**

The HNPF is in Lancaster County in southeastern Nebraska, approximately 19 miles south of Lincoln and 1.5 miles north of Hallam (Figure 1). The site is in the Section 19, Township 7 North, Range 6 East, which is owned by NPPD. Section 19 is also the location of the present coal-fired NPPD Sheldon Power Station, with the entombed reactor located on 18 acres slightly southeast of the center of the 640-acre site.

The Lancaster County, Nebraska, land and title records have been annotated appropriately regarding the remainder of the dismantled facility (AEC 1971). A copy of the Lease Agreement between NPPD and AEC, which includes the legal description of the 18-acre site, is included in Appendix A.

Directions and mileage to the site from the Lincoln Municipal Airport are as follows:

- Take U.S. Interstate Highway 80 west to the first exit (the bypass).
- Proceed south on U.S. Highway 77 for 20 miles to the Hallam exit (2.5 miles south of Princeton).
- After exiting, drive 2 miles toward Hallam.
- Just before Hallam (0.5 mile), turn north on the gravel road and proceed 1 mile, then turn west for 1 mile.
- Power plant should be obvious at this point.

#### **2.1.2 Hydrogeology**

The Hallam Site lies within glacial-drift hills near the upper end of the Olive Branch drainage basin, which is a tributary to Salt Creek. The site is on a topographic high, at an elevation of approximately 1,440 feet (ft) above mean sea level, and is well drained. Water from precipitation moves overland or underground toward points of discharge along Olive Branch, which flows into Salt Creek, and then into the Platte River. Surface water from Salt Creek is not used for drinking purposes and is rarely diverted for irrigation.

The site is underlain by unconsolidated Pleistocene deposits as much as 400 ft thick, consisting of clay, silt, sand, and gravel. These deposits overlie Permian limestone and shale bedrock. The pre-existing valley in the bedrock beneath the site was filled with large quantities of clay, silt, sand, and gravel transported by the glacial ice sheets during Quaternary time. The vast quantities of sand and gravel that were laid down during the Kansan glacial epoch constitute the most important (regional) aquifer in the area. Groundwater also occurs in intermittent shallow perched zones beneath the site.

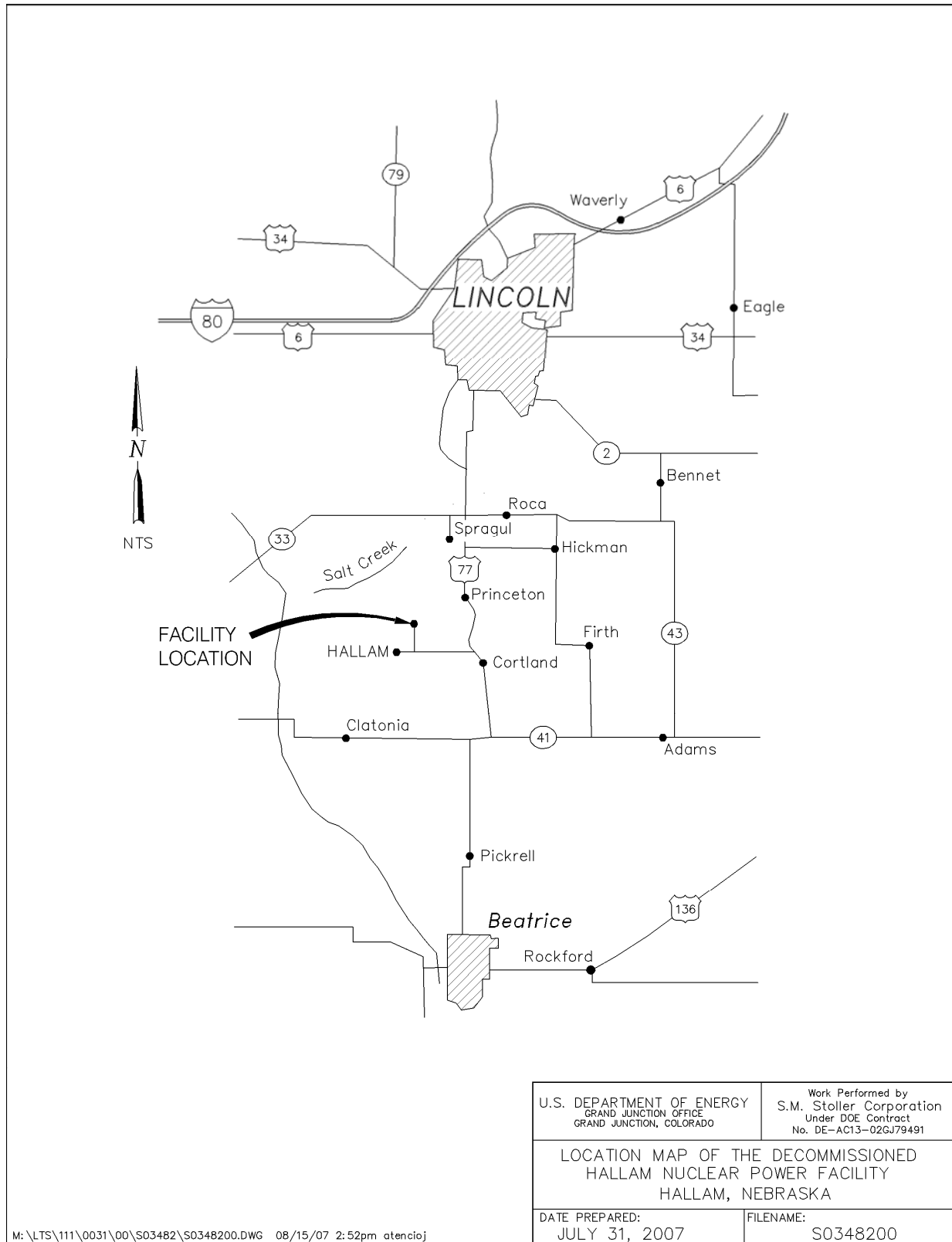


Figure 2-1. Location Map of the Decommissioned Hallam Nuclear Power Facility

Saturated unconsolidated sand and gravel glacial deposits lie on top of the bedrock and form the regional aquifer. These deposits may be assumed to be a single aquifer because they have ample permeability and are generally interconnected. Groundwater from the regional aquifer is used to supply domestic, stock, irrigation, industrial, and public-supply wells, and the aquifer is a prolific producer. The saturated thickness ranges from only a few feet to more than 200 ft. Depth to the regional water table ranges from less than 10 ft in the valley of Olive Branch to more than 180 ft below the highest hills. Groundwater flow in the regional aquifer is generally to the east beneath the site. Recharge to the regional aquifer is by underflow from areas to the west. The amount of local recharge from precipitation to the regional aquifer is very small because glacial till serves as a barrier to downward migration of water. Groundwater from the regional aquifer discharges along Olive Branch and its tributaries.

A series of production wells were installed in the regional aquifer beneath the site in 1959 ranging in depth from 255 to 288 ft. The thickness of clay and fine-grained materials overlying transmissive zones ranged from approximately 70 to 160 ft. Initial static water levels ranged from 120 to 150 ft, and sustained yield from the wells during initial testing was in the range of 900 gallons per minute (gpm).

Intermittent shallow perched groundwater zones (perched aquifer) occur in small bodies of sand and gravel and surficial loess deposits that rest on compact deposits of relatively impermeable glacial till. Depth to perched groundwater beneath the site ranges from about 5 to 20 ft. Water levels and the extent of perched water are variable and dependent on precipitation. Groundwater flow is also variable depending on the degree of interconnection between the perched zones. Flow in the perched aquifer is generally to the north and northwest beneath the site following surface drainage patterns to discharge areas. Much of the recharge from precipitation within the area becomes soil moisture and is lost to evapotranspiration. Perched groundwater is present in some places in amounts sufficient to supply small yields of water to shallow wells; however, groundwater from the shallow perched aquifer is not used at the Hallam Site.

Aquifer tests (slug tests and flexible wall permeameter) conducted on wells completed in the perched aquifer indicate that aquifer conductivity is generally low and variable. Data gathered during the purging of monitor wells prior to collection of groundwater samples provide an additional estimate of the yield and continuity of the perched aquifer. This indicates the aquifer yield is generally poor and that zones that are marginally productive are few and discontinuous. This assessment is in agreement with the lithologic logs produced during well drilling.

The clay and fine-grained material (70 to 160 ft thick) beneath the sandy zones at the site causes perching of the shallow groundwater and inhibits vertical migration of the shallow groundwater to the regional aquifer. This natural flow barrier essentially eliminates the potential for groundwater adjacent to the entombed reactor to migrate to the regional aquifer. In addition, if the isolation structure ever failed, contaminant transport would likely be minimal because of the low hydraulic conductivity and the favorable ion-exchange capacity of the soils and sediments underlying the site. As percolation occurs through the considerable thickness of clay and silt soils and sediments, there is ample opportunity for adsorption, ion exchange (with sodium and calcium), and, because of long travel times, radioactive decay.

### **2.1.3 Climate**

The Hallam area in southeastern Nebraska is characterized by a continental climate subject to a wide seasonal range in temperature. Light rainfall, hot summers, and severe winters are typical in the area. Average annual precipitation in the area is 27.5 inches. The mean daily summer temperature is 76 °F, while the mean daily winter temperature is 28 °F. Maximum seasonal temperatures range from 110 to –29 °F. Prevailing winds are from the north during February, March, and April, and from the south during the rest of the year. Strong winds are common, with an average annual wind velocity of 10.5 miles per hour. Nebraska is on the western edge of the tornado belt, with rare tornados most often in the spring.

## **2.2 Site History**

The HNPF was a 240-megawatt (thermal), sodium-cooled, graphite-moderated demonstration nuclear reactor built and operated by AEC between 1962 and 1964 (Appendix A). Testing of the reactor began in August 1961. Failure of the moderator elements occurred in February 1964 and the reactor was shut down in September 1964. The AEC contract for operating the HNPF was terminated due to technical problems associated with the reactor core in August 1965, and AEC announced HNPF would be decommissioned in June 1966. NPPD was authorized to decommission and dismantle the facility in 1967. The facility was dismantled and placed in a safe condition (entombment) between 1967 and 1969 and retired by AEC in 1971. Although there is currently no evidence of contamination being released from the facility, DOE is responsible for the radioactive materials remaining at the site.

Following its shutdown, reactor fuel and most radioactive materials were removed from the site. The final dismantled condition of HNPF consists of a massive below-grade reinforced concrete and steel structure that is encapsulated and sealed. The isolation structure was originally designed as containment for an operational nuclear power plant and thus can be expected to retain its integrity for an indefinite period of time (DOE 1993). Radioactive materials are stored in steel lined cavities that are surrounded by several feet of concrete and other structural shielding materials. Most of the radioactive material is immobile since it is in the form of neutron-activation products dispersed in metallic components. The inventory of significant radionuclides remaining at the site includes iron-55, cobalt-60, nickel-63, and samarium-151. Levels of activity in the storage areas have been significantly reduced since entombment due to radioactive decay. Of the radionuclides present at significant activity levels at the time of entombment, only nickel-63 and samarium-151, with half-lives of approximately 100 years and 90 years, respectively, would still be present at between 80 to 90 percent of their original activity levels (ORISE 1994a, 1994b). The inventory of radioactive materials at the time of decommissioning is appended as part of Docket 115-3 between NPPD and AEC (Appendix B). Decay and dose calculations indicate that DOE can release the decommissioned reactor for unrestricted use about 100 years after decommissioning (AEC 1971).

## **2.3 Stabilization/Isolation Approach**

The final dismantled condition of the HNPF consists of a massive, below-grade reinforced concrete structure. The reactor building was razed, and the surface of the remaining structure has been weatherproofed by covering with sand, and waterproof polyvinyl membrane and earth. This cover was sloped for positive drainage and drain tile was installed at the periphery.

The intermediate heat exchanger (IHX) structure, which protrudes above grade, was weatherproofed by a layer of polyvinyl sheet and a protective cover of concrete. This approach is intended to preclude the ingress of water to interior portions of the structure. Human access to the entombed structure can be gained only by extensive effort utilizing a combination of explosives, air hammers, and cutting tools.

Prior to final sealing of the facility, all nuclear fuels and all bulk sodium were removed from the site. Residual sodium was reacted with steam to form sodium hydroxide, thus removing any potential for hydrogen formation at some later date should water enter the facility.

Within the structure that housed the reactor, three principal locations were utilized for long-term storage of most of the radioactive materials that remained at the site. These locations are the reactor cavity, fuel storage in pit no. 3, and the moderator element storage cells. Each of these cavities is steel-lined and surrounded by several feet of concrete and other structural material that were provided for shielding in the operational plant. Approximately 300,000 curies of radioactive material were stored at these locations, with more than 99 percent of it located in the reactor cavity. Most of this activity is immobile since it is in the form of neutron activation products dispersed in metallic components.

The former radioactive waste disposal building remains on site. No significant amount of radioactive material remains in this building. The below-grade portions of this building and a connecting pipe tunnel have been sealed to prevent access. All cavities in which radioactive components are stored have been sealed by welded closures in such a manner that they are isolated from the rest of the structure. All other cavities, pipe ways, and stair wells were sealed by welding existing closures or providing a closure constructed of reinforced expanding concrete (AEC 1971).

## **2.4 Site Information**

The site plan for the HNPF is included in this document as Figure 2.

Documents describing the contents and construction of the isolation structure were sealed in two capsules composed of 24×19×4-inch stainless-steel boxes which were secured at two accessible locations in the isolation structures: (1) in a niche cut into the IHX vaults superstructure, and (2) at the center of the steel plate covering the reactor vessel loading face shield. The documents contained in the capsules and the construction and mounting of the capsules are described in detail in Paulett (1969).

The first capsule in the IHX vaults superstructure was set into a niche in the south face of the superstructure at a point due north of the center of the reactor vessel loading face shield. The capsule was covered by a stainless-steel plaque engraved with a warning notice providing information on the location of the structures containing radioactivity and the location of documents pertaining to the structures. The second capsule in the reactor centerline is buried beneath the isolation structure protective covering and provides a warning regarding the presence of radioactive material that is not to be disturbed unless authorized.

## **2.5 Groundwater Conditions**

The groundwater monitoring program to date involves collection of groundwater samples annually from 17 monitor wells and measurement of groundwater levels from 19 monitor wells (Figure 2). The 19 monitor wells are completed in the perched aquifer in eight clusters surrounding the facility and are screened at depths of approximately 25 ft (“A” series), 50 ft (“B” series), and 75 ft (“C” series) (Appendix A). Samples are analyzed for gross alpha, gross beta, nickel-63, tritium, and gamma-emitting radionuclides.

Nickel-63 and gamma-emitting radionuclide activities were not detected in any sample above their respective detection limit. Tritium activity was below the detection limit in the majority of samples. In the few samples that had detectable tritium, the activity was near the detection limit; therefore, these detections are considered a product of the uncertainty in the analytical method (counting statistics) rather than an actual contaminant in the groundwater. Gross alpha and gross beta activities have been consistently detected in groundwater samples collected at the Hallam Site. However, because gross alpha and gross beta activities have been low and consistent over time, these activities are attributed to naturally occurring radionuclides (e.g., uranium and uranium decay chain products) in the groundwater. Analytical results from the 2007 sampling indicated some elevated gross alpha activity exceeding 15 picocuries per liter (pCi/L). The U.S. Environmental Protection Agency (EPA) standard for gross alpha-particle activity (excluding radon and uranium) is 15 pCi/L. Historically, radon and uranium have not been subtracted from the reported gross alpha results at the Hallam Site. DOE re-analyzed a subset of the 2006 samples for gross alpha and also for total uranium. The results of the re-analysis confirm the original gross alpha values. When the total uranium contribution is subtracted from the gross alpha activities, all gross alpha measurements are well below 15 pCi/L.

Analytical results of groundwater samples through June 2007 have revealed no detectable radiological release from the Hallam Site and no evidence of any impact to groundwater in the shallow perched zones. Results have been consistently at or near detection limits for all analytes over the period of time DOE has been monitoring groundwater. Analytical results from July 1998 through June 2007 are available in the DOE SEEPro database, which is available on the DOE website at [www.lm.doe.gov](http://www.lm.doe.gov).

Groundwater levels in the shallow perched aquifer have been relatively consistent over time with minor variations resulting from precipitation and infiltration.

## **2.6 Specific Site Surveillance Features**

Since the HNPF site is on property owned and institutionally controlled by NPPD, fencing, signs, and property markers all fall under the jurisdiction of NPPD. DOE will inspect the following specific features:

- IHX structure, which protrudes above grade.
- 19 monitor wells.
- The 1.4-acre, grass-covered mounded area.

There is a permanent plaque on the side of the IHX structure that provides some information about the reactor entombment. Encased behind the plaque is information regarding the entombment of the HNPF.



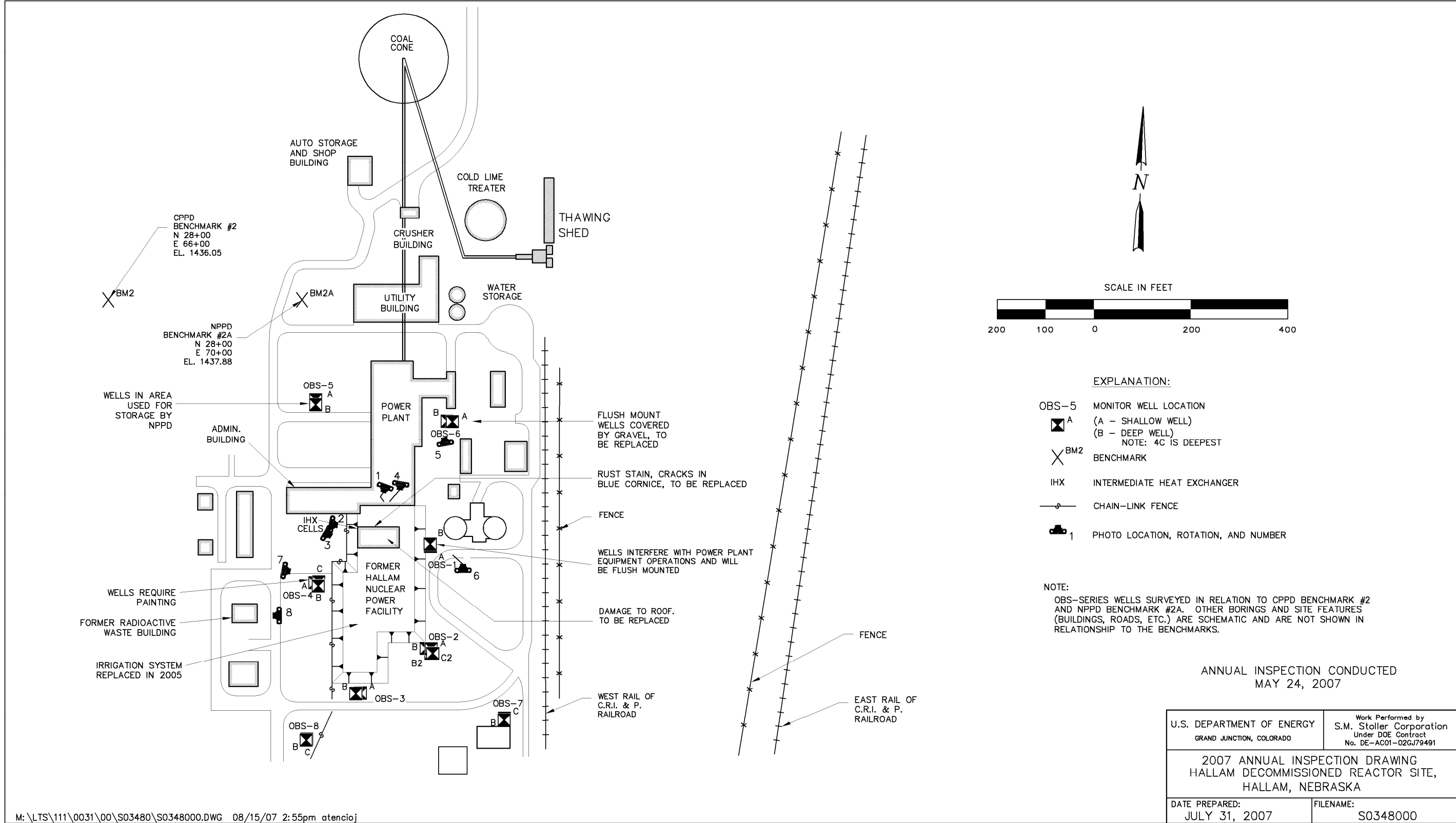


Figure 2-2. Hallam Nuclear Power Facility Site Plan

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## **3.0 Long-Term Surveillance Program**

### **3.1 Environmental Monitoring and Inspection**

#### **3.1.1 Groundwater Monitoring**

Although the potential for transport of radioactive materials stored in the isolation structure to the environment is insignificant, AEC made arrangements with NDH to conduct environmental radiological surveillance to verify that no radionuclides are released to the environment (DOE 1993). After entombment, a surveillance and monitoring program was initiated in 1970 by NDH and was funded by AEC, which included analyzing groundwater samples from the deep production wells (groundwater from the regional aquifer at depths greater than 180 ft) at the Sheldon Power Station. NDH was concerned in 1990 about the possibility of shallow groundwater coming in contact with buried radiological materials along the buried walls of the reactor. Subsequently, DOE and NDH agreed to further characterize hydrologic conditions and establish a monitoring program in the shallow perched groundwater zones in the vicinity of the HNPF.

Groundwater monitoring has been conducted on an annual basis at the Hallam Site through June 2007. It was recommended in a DOE report (DOE 2006) that groundwater monitoring be discontinued because analytical results since 1970 demonstrated no impact to shallow perched groundwater and there is no current or anticipated unacceptable risk to human health and the environment. The State of Nebraska responded to DOE in a letter dated February 2, 2007, indicating they did not concur with DOE recommendations but would accept reduction of sampling and analysis frequency to once every 2 years (State of Nebraska 2007). DOE responded to the State of Nebraska in a letter of March 14, 2007 (DOE 2007a). Consequently, the next sampling event at the Hallam Site will occur in June 2008, with an additional event during June 2010. The above correspondence is included in Appendix C.

DOE has 19 monitor wells at the site with groundwater samples analyzed for gross alpha, gross beta, tritium, nickel-63, and gamma spectrometry. The remaining two wells are for water level measurements only because of very slow recovery rates. Location of DOE monitor wells are shown on Figure 3. Analytical results from monitoring will be evaluated and reported every 2 years, and a decision will be made regarding ongoing monitoring based on potential impact to human health and the environment.

#### **3.1.2 Visual Site Inspection**

The concrete-encased IHX structure that protrudes above ground will be inspected for signs of deterioration or other damage. The 1.4-acre, grass-covered mounded area will be checked to assure the grass is healthy and that no erosion is occurring on the side slopes. Monitor wells will be examined for damage or deterioration that may require repair.

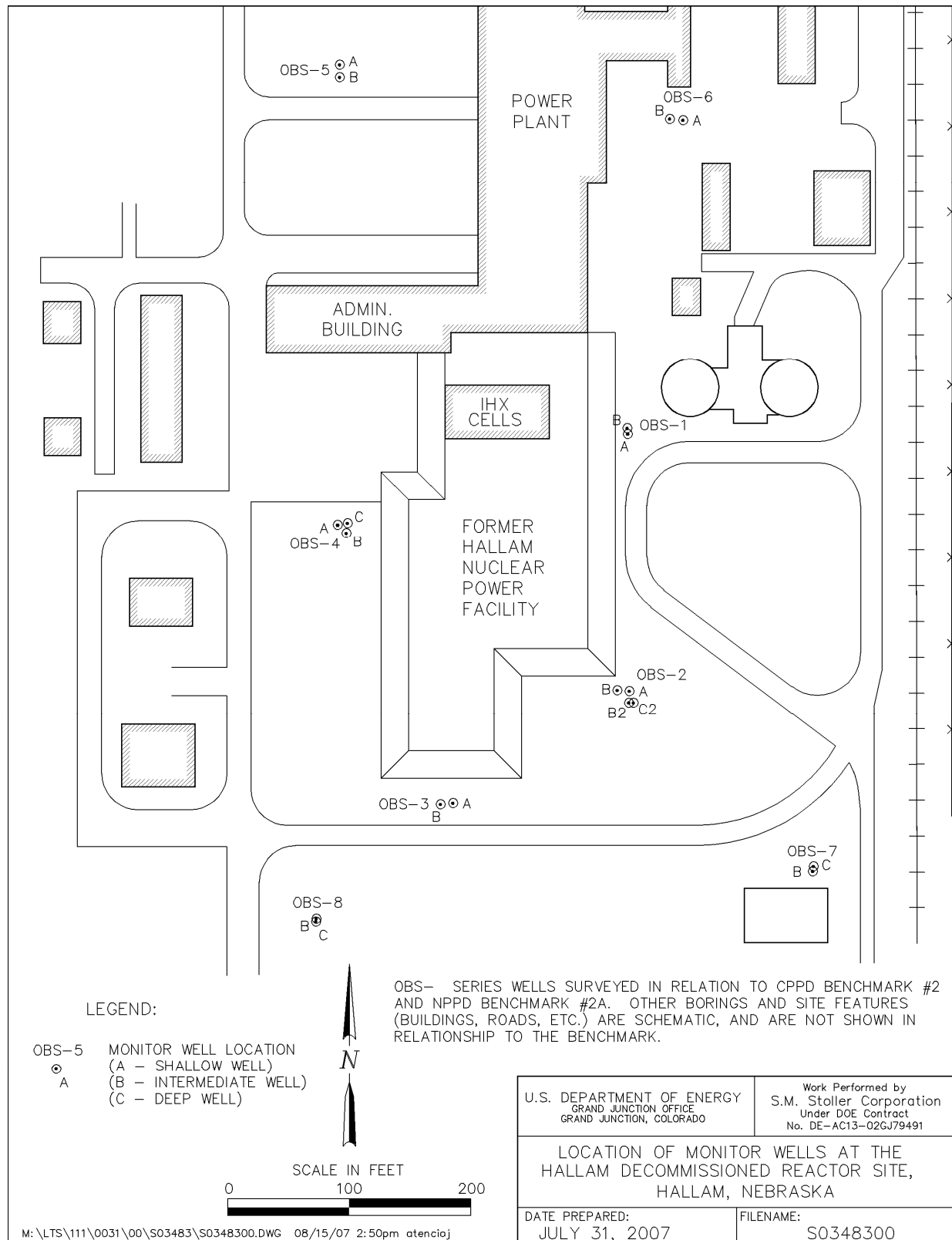


Figure 3-1. Location of Monitor Wells at the Hallam Site

## **3.2 Monitoring and Inspection Report**

DOE will compile a periodic inspection and status report following physical site inspections and groundwater sampling events. The report will be posted on the DOE-LM website at <http://www.lm.doe.gov/land/sites/ne/hallam/hallam.htm>. This report will discuss inspection results, including status of the IHX structure, buried concrete structure, monitor wells, results of groundwater monitoring, and any long-term surveillance and maintenance issues. The report will also include any recommendations for site maintenance.

## **3.3 Maintenance and Emergency Measures**

### **3.3.1 Custodial Maintenance**

DOE is responsible for making any necessary repairs to the concrete-encased intermediate heat exchanger structure (AEC 1971). This may require periodic sealing and other concrete repairs to maintain integrity.

### **3.3.2 Emergency Measures**

Emergency measures are the actions that DOE will take in response to “unusual damage or disruption” that threaten or compromise site safety, security, or integrity. DOE will contain or prevent dispersal of radioactive materials in the unlikely event of a breach in site containment materials.

## **3.4 Records**

DOE-LM receives and maintains selected records at the office in Grand Junction, Colorado, to support post-closure site maintenance. Inactive records are preserved at a Federal Records Center. Site records contain critical information required to protect human health and the environment, manage land and assets, protect legal interests of DOE and the public, and mitigate community impacts resulting from the cleanup of legacy waste. The records are managed in accordance with the following requirements.

- Title 44, *United States Code* (U.S.C.), Chapter 29, “Records Management by the Archivist of the United States and by the Administrator of General Services;” Chapter 31, “Records Management by Federal Agencies;” and Chapter 33, “Disposal of Records.”
- Title 36, *Code of Federal Regulations* Chapter 12, Subchapter B, “Records Management.”
- DOE G 1324.5B, *Implementation Guide*.
- *LM Information and Records Management Transition Guidance*.

## **3.5 Quality Assurance**

The long-term custody of the HNFP and all activities related to the surveillance and maintenance of the site will comply with DOE Order 414.1C, *Quality Assurance* (DOE 2005). Quality assurance requirements are routinely fulfilled by use of a work planning process, standard operating procedures, trained personnel, documents and records maintenance, and assessment

activities. Requirements will be transmitted through procurement documents to subcontractors if/when appropriate.

### **3.6 Health and Safety**

Health and safety requirements and procedures for DOE-LM activities are consistent with DOE Orders, federal regulations, and applicable codes and standards. The DOE Integrated Safety Management process serves as the basis for the Contractor's Health and Safety Program.

Specific guidance is contained in the *Office of Land and Site Management Project Safety Plan* (DOE 2007b) or current guidance. This Project Safety Plan identifies specific hazards associated with the anticipated scope of work and provides direction for the control of these hazards. During the pre-inspection briefing, personnel are required to review the plan to ensure that they have an understanding of the potential hazards and the health and safety requirements associated with the work to be performed. Health and safety concerns specific to the HNPF are listed in an inspection checklist.

## **4.0 References**

AEC (U.S. Atomic Energy Commission), 1971. "Nebraska Public Power District (Formerly Consumers Public Power District), Docket No. 115-3, Hallam Nuclear Power Facility, Order Termination Authorization," Washington, DC, July.

DOE (U.S. Department of Energy), 1993. *Environmental Restoration and Waste Management Plan: Volume VIII – Hallam Nuclear Power Facility*, DOE/CH-9226, January.

DOE (U.S. Department of Energy), 2005. *Quality Assurance*, DOE Order 414.1C, June.

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DOE (U.S. Department of Energy), 2007a. Letter to State of Nebraska of March 14, 2007 Regarding Discontinuing Monitoring at the Hallam Site.

DOE (U.S. Department of Energy), 2007b. *Office of Land and Site Management Project Safety Plan*, DOE-LM/GJ1116-2006, January.

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ORISE (Oak Ridge Institute for Science and Education), 1994b. *Project Work Plan for Phase II of the Investigation of Perched Groundwater at the Hallam Nuclear Power Facility, Hallam, Nebraska*, ORISE 94\G-36, July.

Paulett, T.A., 1969. "Storage of Engineering Documents in the HNPF Retirement Complex," *Atoms International*, TI-690-12-002.

State of Nebraska, 2007. Letter to DOE of February 2, 2007, Regarding Discontinuing Monitoring at the Hallam Site.

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## **Appendix A**

### **Lease Agreement**

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LEASE OF LAND  
 BETWEEN  
 CONSUMERS PUBLIC POWER DISTRICT  
 AND  
 THE U. S. ATOMIC ENERGY COMMISSION

This LEASE is entered into this 24th day of July, 1959, effective as of January 16, 1959, between the UNITED STATES OF AMERICA (called the "United States" or "Commission"), and CONSUMERS PUBLIC POWER DISTRICT, a public corporation and political subdivision of the State of Nebraska, with its principal office located at Columbus, Nebraska (called "Consumers").

Recitals

On September 20, 1957 the Government and Consumers entered into a contract identified as Contract No. AT(11-1)-513 (hereinafter called the "contract") pursuant to which, inter alia, the Commission has undertaken to furnish a nuclear reactor plant (utilizing certain facilities provided by Consumers) for the production of steam for the generation of electricity in Consumers' turbogenerator and related conventional type power facilities, the Lessor to furnish the site for the overall plant. The contract is in connection with and in furtherance of the Commission's civilian reactor program. Under the contract Consumers agrees to lease to the Government, rent-free and for a term of forty years, the parcel of land on which the reactor and related facilities are to be located, together with rights of ingress and egress over the adjacent tracts of land to which Consumers holds title.

The land hereby leased has been acquired by Consumers for the purpose of leasing it to the Government and is not otherwise necessary for use by Consumers in its operations; therefore, this lease is permitted under the terms of Consumers' Bond Resolution.

NOW THEREFORE, the parties agree as follows:

In consideration of the commitments and obligations of the parties under the contract and of One Dollar (\$1.00) and other good and valuable considerations, the receipt and sufficiency of which are hereby acknowledged, Consumers does hereby lease and demise to the Government the following described tract of land located in Section 19, T-7-N, R-6-E, Lancaster County, State of Nebraska;

From the south east corner of said Section 19, T-7-N, R-6-E, thence 2479.6 feet north and 957 feet west to the point of beginning; thence west 920 feet; thence south 550 feet; thence east 920 feet; and thence north 650 feet to the point of beginning,

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Lease of Land

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together with a right of ingress and egress over and along a roadway to be provided by Consumers to and from an existing public road;

This lease shall be for a term commencing on the 16th day of January, 1959 and ending on the 15th day of January, 1999, unless sooner terminated as herein provided or by consummation of a sale of the nuclear facilities to Consumers resulting from exercise of its option therefor under the contract.

The Government shall have no obligation to pay rent for the demised land. Consumers' title in fee simple to the demised premises is hereby warranted by Consumers.

The parties further agree to the following terms and conditions:

ARTICLE I

In accordance with the provisions of the contract and for the purpose of performance of the work thereunder, Consumers shall have the right, during the term of the contract and any extensions thereof, to occupy and use jointly with the Government the property covered by this lease. Subsequent to the expiration or termination of the contract, the Government, acting directly or through contractors of its choice, shall have the right, during the existence of this lease, to utilize the demised land.

ARTICLE II

The Government shall have the right, during the existence of this lease, to erect structures, install equipment, attach fixtures and make any other changes beneficial to the operation of the facilities to, in, or upon the leased property. Subject to Consumers' rights under the contract such structures, equipment, fixtures, or other devices provided by the Government shall be and remain the property of the Government and may be removed or otherwise disposed of by the Government.

ARTICLE III

The Government may terminate this lease at any time by giving Consumers a six-months written notice in advance.

ARTICLE IV

Upon expiration or termination of this lease, subject to Consumers' rights under the contract the Commission shall at its expense make the premises safe from a radiation standpoint and may, but will be under no obligation to restore the leased land to its original condition or remove any or all Government-owned portions of the nuclear plant, facilities, components or equipment.

ARTICLE V

Consumers owns premises known as the Hallam Site, of which the demised premises are a part, consisting of approximately 640 acres, to the north

APPENDIX 1

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P. 004

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Lease of Land

Page No. 3

of Hallam, Nebraska. Said Hallam Site consists of Section 19 (except existing right-of-way of Chicago, Rock Island, and Pacific Railway Co.), T-7-N, R-6-E, located in Lancaster County, the deeds thereto being recorded in the office of the Register of Deeds in said Lancaster County, reference being made thereto for a more particular description of said tract. Consumers agree that so long as the project defined in the contract continues and for any additional period required to make the property safe for other uses, it will retain title to and control of said Hallam Site and will not permit activities thereon or uses thereof which, under Commission reactor safeguard criteria, are inconsistent with nuclear reactor operations.

ARTICLE VI

The demised premises of sufficient width and at an appropriate location (so as not to interfere with the Commission's use of the premises) for any facilities required during the existence of this lease in connection with the operation of the turbine generator portion of the plant for the generation, transmission, and sale of power.

ARTICLE VII

Consumers also reserves the right on the expiration or termination of this lease to leave on the premises equipment or facilities supplied by Consumers for the nuclear facilities.

ARTICLE VIII

In the event that the contract expires without renewal, or is sooner terminated, Consumers agrees to grant, without charge, to the Government at the Commission's request (a) a right of access to and a right to use, in connection with its activities on the demised premises, any railroad siding or sidings which may be built by Consumers on that part of the site not included in this lease, and (b) rights of way over, across, and under that part of Consumers' site not included in this lease, of sufficient width and at an appropriate location for any facilities required during the existence of this lease in connection with the operation of the nuclear portion of the plant, and (c) a right of use for the nuclear facilities to the system of wells to be constructed by Consumers. Any such grant to the Government shall limit the Government's use to that generally contemplated for a nuclear reactor having requirements similar to those contemplated by the project.

ARTICLE IX

It is agreed that neither party during the existence of this lease will assign this lease or sell or assign its interest in the demised premises or in any improvements remaining thereon or make any subleases thereof to any person or persons without the previous written consent of the other party hereto. Both parties recognize that utilization of radiation may make it desirable for others to build and operate facilities on the demised land, in which case the approval of both the Government and Consumers will be required.

APPENDIX 1

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Lease of Land

Page No. 4

ARTICLE X

Consumers warrants that no person or selling agency has been employed or retained to solicit or secure this lease upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by Consumers for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this lease without liability or in its discretion to deduct from the contract price or consideration the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XI

No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this lease or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this lease if made with a corporation for its general benefit.

ARTICLE XII

Consumers agrees that the Comptroller General of the United States or any of his duly authorized representatives shall until the expiration of three years after final payment of the agreed rental, have access to and the right to examine any directly pertinent books, documents, papers and records of Consumers involving transactions related to this lease.

ARTICLE XIII

Any notices required hereunder shall be sufficient if sent to the appropriate party at the addresses indicated below:

Manager, Chicago Operations Office  
U. S. Atomic Energy Commission  
P. O. Box 59  
Lemont, Illinois

General Manager  
Consumers Public Power District  
Columbus, Nebraska

IN WITNESS WHEREOF, the parties hereto have executed this lease on the date first above written.



THE UNITED STATES OF AMERICA

By Kenneth A. Dunbar  
Kenneth A. Dunbar, Manager  
Chicago Operations Office  
U. S. Atomic Energy Commission

CONSUMERS PUBLIC POWER DISTRICT  
By Walter A. Brader  
President

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Lease of Land

Page No. 535

STATE OF NEBRASKA )  
PLATTE COUNTY ) ss.

On this 14th day of July, 1959 before me, the undersigned, a Notary Public in and for said County, personally came Wayne E. Barber, President of Commuters Public Power District, to me known to be the President and the identical person whose name is affixed to the above Lease, and acknowledged the voluntary act and deed of said District and that the seal of said District was thereto affixed by its authority.

WITNESS my hand and Notarial Seal the day and year last above written.



Catherine Frischnot  
Notary Public

Commission expires Dec. 18, 1961

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## **Appendix B**

### **Agreement Between NPPD and AEC**

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**Department of Energy  
Office of Legacy Management**

Washington, D C 20585

SEP 16 2004

OLM-SRS-2004- 12

Mr. Robert A. Green  
Nebraska Public Power District  
P.O. Box 499  
Columbus, NE 68602-0499

Subject: Department of Energy Access to the Hallam, Nebraska, Decommissioned Reactor

Dear Mr. Green:

In 1993, The U.S. Department of Energy (DOE), Chicago Operations Office, signed a license agreement with the Nebraska Public Power District (NPPD) to conduct remedial activities and to ensure access to the decommissioned Hallam Nuclear Power Facility at the Sheldon Power Station near Hallam, Nebraska. The agreement allows DOE to fulfill its obligation under U.S. Atomic Energy Commission (DOE) Docket 115-3, dated July 20, 1971, to ensure the radiological safety of the facility. The agreement has undergone two modifications to the term and expired in 2000. DOE has completed the installation of monitoring wells needed to monitor the ground water around the site as required in the license agreement.

As stated in the docket, the right of access to the facility for monitoring purposes was reserved for the DOE. Therefore, it has been determined that DOE currently has access to the facility and does not need to renew the 1993 license agreement.

Thank you for your continued support. If you have questions or concern, please contact Charles W. (Bill) Montana, Jr., Realty Officer, at (702) 295-1899 or (702) 630-0379.

Sincerely,

A handwritten signature in black ink, appearing to read "Steve Schiesswohl".

Steven R. Schiesswohl  
Realty Officer

cc: C. Montana, DOE/LM-30  
M. Tucker, DOELM-50  
C. Bahrke, Stoller (e)  
C. Carpenter, Stoller (e)  
M. Widdop, Stoller (e)  
Project File HAL015.10 (DOE)

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UNITED STATES  
**ATOMIC ENERGY COMMISSION**  
WASHINGTON, D.C. 20545

NEBRASKA PUBLIC POWER DISTRICT  
(FORMERLY CONSUMERS PUBLIC POWER DISTRICT)  
DOCKET NO. 115-3  
HALLAM NUCLEAR POWER FACILITY  
ORDER TERMINATING OPERATING AUTHORIZATION

The Atomic Energy Commission has found that the Hallam Nuclear Power Facility located in Hallam, Nebraska, has been dismantled and disposition has been made of the component parts in accordance with the regulations of the Commission in 10 CFR Chapter I, and in a manner not inimical to the common defense and security or to the health and safety of the public. Therefore, in accordance with the December 15, 1969 application by Nebraska (formerly Consumers) Public Power District and supplements dated February 9 and June 26, 1970, Operating Authorization No. DPRA-1 is hereby terminated as of the date of this order.

FOR THE ATOMIC ENERGY COMMISSION

*Peter A. Morris*  
Peter A. Morris, Director  
Division of Reactor Licensing

Date of Issuance: July 20, 1971

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UNITED STATES ATOMIC ENERGY COMMISSION

DOCKET NO. 115-3

NEBRASKA PUBLIC POWER DISTRICT

(FORMERLY CONSUMERS PUBLIC POWER DISTRICT)

HALLAM NUCLEAR POWER FACILITY

NOTICE OF TERMINATION OF OPERATING AUTHORIZATION

The Atomic Energy Commission has terminated Operating Authorization No. DPRA-1 which authorized the Consumers Public Power District (CPPD), now the Nebraska Public Power District, to operate the Hallam Nuclear Power Facility (HNPF) located in Hallam, Nebraska. On November 3, 1967, the Commission issued an order authorizing CPPD to dismantle the HNPF and decontaminate the facility in accordance with the HNPF Retirement Plan (Revised) and the Final Summary Safeguards Report, Supplement 5.

Representatives of the Commission have inspected the HNPF and have verified that it has been dismantled and disposition made of its component parts as described in the HNPF Retirement Plan (Revised). The Commission inspectors have further verified that the premises are safe from a radiation standpoint for unrestricted occupancy in accordance with the requirements of 10 CFR Part 20. In addition, an appropriate notice regarding the remainder of the dismantled facility has been placed in the land title records of Lancaster County, Nebraska. The HNPF was Commission-owned; consequently, the Commission has title to and responsibility for the entombed radioactive materials.

Accordingly, the Commission has found that termination of Operating Authorization No. DPRA-1 for the HNPF will not be inimical to the common defense and security or to the health and safety of the public,

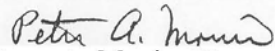
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Copies of (1) the Commission's Order Terminating Operating Authorization (2) a related Safety Evaluation by the Commission's Division of Reactor Licensing, and (3) the CPD application for termination dated December 15, 1969, and supplements dated February 9 and June 26, 1970, are available for inspection at the Commission's Public Document Room, 1717 H Street, N.W., Washington, D. C. A copy of each of items (1) and (2) may be obtained upon request sent to the U. S. Atomic Energy Commission, Washington, D. C. 20545, Attention: Director, Division of Reactor Licensing.

Dated at Bethesda, Maryland, this 20th day of July, 1971.

FOR THE ATOMIC ENERGY COMMISSION

  
Peter A. Morris, Director  
Division of Reactor Licensing

DOCKET-1153--18

UNITED STATES ATOMIC ENERGY COMMISSION  
SAFETY EVALUATION BY THE DIVISION OF REACTOR LICENSING  
RETIREMENT OF THE HALLAM NUCLEAR POWER FACILITY  
DOCKET NO. 115-3

INTRODUCTION

By order of the Atomic Energy Commission dated November 3, 1967, Nebraska Public Power District<sup>1</sup> (NPPD) was authorized to retire and dismantle the Hallam Nuclear Power Facility (HNPF) in accordance with a "Retirement Plan" approved by the Commission.

The HNPF was a Commission-owned sodium-cooled, graphite-moderated reactor operated by NPPD at its Sheldon Station near Hallam, Nebraska, in accordance with an operating authorization issued under the Commission's regulation, 10 CFR 115. The Commission concluded in June 1966 that the HNPF had fulfilled its objectives in the Power Demonstration Program, and at that time began plans for retirement of the facility. The dismantling activities have now been completed, and NPPD has requested that Operating Authorization No. DPRA-1 be terminated. In support of this request, NPPD submitted "Final Status Report and Safety Analysis of the Hallam Nuclear Power Facility and Remaining Structures" (AL-AEC-MEMO-12794 - Revised) dated September 30, 1969, and a letter dated June 26, 1970, which amplifies and corrects this report. These documents describe the activities undertaken to retire the facility, set forth the condition of the dismantled facility, provide an inventory of the remaining radioactive materials and assess the safety aspects related to long-term storage of such materials at the site.

Facility Status after Dismantlement

In its dismantled condition, the HNPF consists of a massive, below-grade reinforced concrete structure, within which a number of cavities are located. These cavities formerly housed the reactor, those portions of the heat transfer and auxiliary systems that contained radioactive sodium or other radioactive fluids, and storage locations for radioactive materials. All of these cavities have been sealed. The reactor building has been razed, and the surface of the remaining structure has been weatherproofed by covering with sand, a waterproof polyvinyl membrane and earth. This

<sup>1</sup>Nebraska Public Power District was formerly named Consumers Public Power District.

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cover is sloped for proper drainage and drain tile is installed at the periphery. The intermediate heat exchanger (IHX) structure, which protrudes above grade, has been weatherproofed by a layer of polyvinyl sheet and a protective cover of concrete. In this condition, interior portions of the structure are sealed against ingress of water and access can be gained only by extensive effort utilizing a combination of explosives, air hammers and cutting tools. The only other HNPF structure remaining at the site is the radioactive waste disposal building, a relatively small structure previously used in connection with storage and handling of wastes.

Prior to final sealing of the facility, all nuclear fuel and all bulk sodium were removed from the site. Residual sodium was reacted with steam to form sodium hydroxide, thus removing any potential for hydrogen formation at some later date should water enter the facility. Equipment that could be salvaged economically was decontaminated, where necessary, and shipped from the site for utilization elsewhere.

Within the structure that housed the reactor, three principal locations were utilized for long-term storage of most of the radioactive materials that will remain at the site. These are the reactor cavity, Fuel Storage Pit No. 3, and the moderator element storage cells. Each of these cavities is steel lined and surrounded by several feet of concrete and other structural materials that were provided for shielding in the operational plant. Approximately 300,000 curies of radioactive material are stored in these locations with over 99% of it being located in the reactor cavity. Most of this activity is immobilized since it is in the form of neutron activation products dispersed in metallic components. A small amount of activation products is immobilized in the shielding concrete surrounding the reactor cavity. In addition to the activity stored in these principal storage locations, eight other locations within the structure contain a total of approximately 1/4 curie of activity in the form of activation products dispersed in metallic components. No significant amount of radioactive material remains in the radioactive waste disposal building. However, the below-grade portions of this building and a connecting pipe tunnel have been sealed to prevent access.

All of the cavities in which radioactive components are stored have been sealed by welded closures in such a manner that they are isolated from the rest of the structure. In addition, all other cavities, pipe ways and stair wells have been sealed by welding existing closures or providing a closure constructed of reinforced expanding concrete.



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Radiological Status of Accessible Locations

After the retirement activities were completed, a radiation survey was performed to verify that radiation levels would not be high enough to present a hazard even if it were assumed that the general public could have unlimited access to the site. This survey showed that in all but one location the radiation levels are at background. The AEC Division of Compliance (CO) has noted from its independent survey that small amounts of activity remain in the silt of the primary and secondary retention ponds which were provided to hold up discharges from the plant. No significant activity was found in the tertiary pond to which the secondary pond drains. Water samples from these ponds were all within the concentrations permitted by 10 CFR Part 20, Column 2, Table II, of Appendix B and Note 1 thereto.

Some silt samples contained concentrations of radioactive materials several times that which would be permitted in an equal weight of water as stated in 10 CFR 20. The fact that such concentrations exist in the silts indicates either that the radioactive material is in very insoluble form or that it is strongly adsorbed by the silt. There is no potential for pond water exceeding 10 CFR 20 limits. The potential for transport of sediments downstream by run-off is very small as indicated by the absence of radioactive material in the tertiary pond. However, should such transport occur as a result of storm run-off, the small total quantity of radioactive material in the pond bottom would be further dispersed and diluted, and it is unlikely that subsequent measurements could detect radiation levels in excess of background beyond the tertiary pond.

The beta-gamma external radiation measurements made by CO indicate some locations in the pond bottom (with water absent) with radiation levels between 0.3 and 0.5 mR/hr at 1 cm from the surface. While these indicated levels are slightly higher than the 0.2 mR/hr average gamma radiation level which the decontamination effort was to achieve, as specified in the HNPFF deactivation procedures, these levels are still well within Section 20.105(b) of 10 CFR 20 limits. Because the radiation monitoring instrument used by CO was equipped with a 2.5 mg/cm<sup>2</sup> GM tube, it was sensitive to both gamma radiation and low energy beta radiation, and the measurements made at 1 cm above the silt would include beta radiation as well as the gamma radiation. The licensee's consultant, Isotopes, Inc., when making the final survey of the pond, used a 35 mg/cm<sup>2</sup> GM tube, which is insensitive to beta radiation with energies less than about 0.2 Mev. The results of the licensee's survey indicated radiation levels of less than 0.2 mR/hr. Silt and vegetation samples gathered by CO and analyzed by the Commission's Idaho Operations Office showed

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radioactivity concentrations of Co-60, Ni-63, Fe-55, Mn-54 and Na-22. The major contributor to the silt concentration (50 to 90 percent) was Ni-63 which decays only by beta emission ( $E_{\max} = 0.066$  Mev). Therefore, comparative evaluation of the radiation survey results of the licensee and CO indicate that a high percentage of the radiation level may be due to the low energy beta radiation from Ni-63. The limits for unrestricted areas specified in Section 20.105 of 10 CFR 20 are applicable to whole body doses and therefore compliance with them should be determined for gamma radiation only at a radiation measuring height of 30 to 36 inches above the source.

Based upon our analysis and evaluation, we have concluded that the licensee has achieved satisfactory decontamination levels and that such levels do not represent an undue risk to the health and safety of the public.

#### STORAGE OF RADIOACTIVE MATERIALS

##### Storage Areas

The three principal locations in which radioactive materials will remain stored are the reactor cavity, fuel and storage pit No. 3, and the moderator storage cells. These storage locations (designated Storage Areas 1, 2, and 3, respectively) are all situated within the below-grade portions of the remaining structure. As previously noted, a small amount of radioactive material, principally in the form of activation products in miscellaneous small parts, is stored within other volumes located in the below-grade structure.

Over 99% of the activity stored at the site is located within the reactor cavity (Area No. 1). This cavity is lined with carbon-steel plate with a minimum thickness of 1/2 inch. The liner represents a high integrity envelope for the cavity since it was designed to be gas tight to retain a helium atmosphere and to exclude in-leakage of water which would have posed a hazard during reactor operation. Remaining within the cavity are the reactor vessel and surrounding guard vessel, with associated double-walled piping, and most of the reactor vessel internals. The cavity closure consists of a massive shield plug which was formerly the loading face of the reactor. In connection with the retirement activities, all sodium piping and vent lines were cut and sealed with welded caps at the diaphragm seals separating the reactor cavity from the adjoining pipeways, thus isolating the reactor cavity

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from the remainder of the structure. All small plugs penetrating the loading face shield have been sealed in place, and the entire shield has been covered by two 1/2-inch-thick steel plates, welded in place to provide a secondary permanent seal.

Substantially all of the radioactive material stored in the reactor cavity consists of activation products dispersed in the stainless steel materials that constitute the reactor vessel and its internals. Lesser amounts of activation products are dispersed in the carbon steel thermal shield and guard vessel which surround the reactor vessel and in the cavity liner itself. The small amount of radioactive material contained in the reinforcing bar and the concrete outside the reactor cavity is too low in concentration to present a potential radiological problem. The following table summarizes the inventory of significant radionuclides remaining in the reactor vessel and outside the reactor vessel as of late 1969 (5 years after reactor shutdown).

Significant Radionuclides in Reactor Cavity (Area No. 1)

Isotope	Reactor Vessel & Internals	External to Reactor Vessel
	Curies	Curies
Fe-55	190,000	10,000
Co-60	73,000	3,000
Ni-63	12,000	Negligible
Sm-151	6,300*	Negligible

\*Located in control elements stored in reactor vessel.

Fuel Storage Pit No. 2, which was used for storage of spent nuclear fuel when the facility was operational, has been designated Storage Area No. 2. This pit is lined by 1/4-inch-thick stainless steel plate, and has suspended in it a number of stainless steel thimbles 40 feet long with 1/4-inch wall thickness. Each of these thimbles was formerly used to store a spent fuel element that had a film of sodium on it; hence they were of leak tight construction to preclude cooling water in the pool from entering the thimbles. The pool has been drained and these thimbles now contain process tubes, control rod tubes, dummy elements and a spent neutron source element, all of which contain induced radioactivity from having been located in the reactor during operation. The

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thimbles have been welded to the steel sleeves through which they are hung in the concrete shield structure constituting the roof of the fuel pit. The upper side constitutes part of the grade level floor of the remaining structure. Closures and dust covers for each thimble have been welded in place to assure water tightness and the interspace has been filled with expanding concrete.

In 1969, five years after shutdown, the inventory of significant radio-nuclides in the fuel storage pit consisted of 2,900 curies of Fe-55, 4,400 curies of Co-60, and 230 curies of Ni-63.

Storage Area No. 3 consists of the 12 moderator-element storage cells which are 20-ft-long cylinders, each 2 ft in diameter, cast in the concrete structure of the main floor of the plant. These cells have steel-encased, concrete shield plugs as closures. The radioactive components stored in them consist primarily of three canistered moderator-elements that had experienced cladding failures during reactor operation. A number of parts such as pumps, valves and segments of piping are stored in these cells. The moderator cells were sealed by welding the plug casings to the cell liners and filling the space above the plugs with expanding concrete. Five years after shutdown (1969), the miscellaneous parts stored in these cells contained about 0.008 curies of activity, and the total inventory, most of it in the form of activation products in the moderator element cladding, consisted of 2,300 curies of Fe-55, 660 curies of Co-60 and 140 curies of Ni-63.

#### Integrity of Storage Structure

The selected storage areas are within a below-grade reinforced concrete structure that was originally designed as containment for an operational nuclear power plant. Thicknesses of concrete, steel and other materials in the vicinity of the storage locations were dictated primarily by shielding considerations for the operational plant. Similarly, the design, in terms of structural strength, took into account combinations of normal structural design loads with loadings that were presumed possible as the result of various hypothetical reactor accidents. Because of these original design considerations, the structure can be expected to retain its integrity for an indefinite period of time. The minimum design-life objective of the various seals, supplementary closures and weatherproofing measures, installed during the dismantling of the facility, is 100 years. Based on our review of the design details of these features, and the design details of the original facility, we conclude that this objective has been met.

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The Division of Compliance (CO) has conducted inspections at the facility and has verified that all of the steps necessary to sealing and weatherproofing the storage structure had been carried out in conformance with the requirements of the approved retirement plan. CO noted that the one-foot-thick concrete slab placed on the roof of the IHX structure had suffered cracking, apparently caused by expansion and contraction that occurred because of changes in temperature. These cracks have been repaired; however, the slab is exposed to weather and some deterioration may be expected to occur in the future. Further cracking of this slab would be of little significance since its purpose is solely to give physical protection to the polyvinyl waterproofing membrane placed on the IHX roof as an additional precaution against inleakage of rainwater. The IHX structure itself, with its 6-112-ft-thick reinforced concrete roof and shield plugs, sealed in place, is inherently leak-tight.

Various conditions have been considered that conceivably could affect the integrity of the structure. These include natural events and conditions that might arise as the result of hydrogen accumulation or corrosion within the structure.

It was determined through evaluation of the structure prior to operation of the plant that tornado wind loadings and tornado-borne missiles could not affect the integrity of the structure because of its location at or below grade elevation and because of the strength of the reinforced concrete. Differential pressures across the structure in excess of those considered possible as a result of the passage of a tornado were found to be incapable of lifting any of the plugs used as closures in the floor of the structure. Additional margin against the possibility of tornado damage has been provided by seal welding of these plugs and by application of a cover of sand and earth after the structure was sealed.

The site is located in Zone 1 of the Uniform Building Code Map of Seismic Probability. Thus, the area is expected to experience earthquakes only infrequently and at magnitudes that would not affect the integrity of the Structure. If an unexpectedly severe earthquake were to occur, it is conceivable that some damage, in the form of cracking, might occur to the concrete. It would be highly unlikely, however, that the integrity of the three designated storage areas would be affected since the steel liners should be sufficiently strong to withstand the forces of an earthquake and sufficiently ductile to accommodate without failure any dimensional

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changes induced by cracking of the concrete. Even if the storage areas were breached, there would be no significant potential for release of radioactivity because most of it is in the form of activation products distributed through and immobilized within metallic structural materials. Any necessary repairs to the structure, to restore its weathertightness, could be made easily, long before corrosion of these materials could lead to the spread of activity.

Flooding at the site is not considered possible because of its elevation and location away from streams. However, the possibility of water invasion from the surface and from ground water was considered in the design of the original facility, as well as in the design of the added sealing features. We have determined that the upper surface of the structure has been sealed to the extent that inleakage of water could not occur unless a small leak path had been left, for example, because of an undetected weld defect. Even if such a defect existed, invasion of water from the upper surface would be minor because of the provisions made for drainage of storm water. The potential for water invasion below grade is somewhat greater because of the frequent existence of high ground water levels at the site. It appears possible that water could enter some of the below-grade cavities in small amounts because of seepage through construction joints or existing cracks in the concrete. Water could not enter the designated storage areas, however, because of the water-tight steel liners that have been provided. It is conceivable, though unlikely, that after prolonged immersion the liner materials could corrode to the point of developing leaks. The consequences of such postulated leakage are discussed in the following section.

Hydrogen evolution owing to sodium-water reaction or radiolytic dissociation of water would be the only potential mechanism through which a condition within the storage structure could threaten its integrity. The potential for hydrogen production by a sodium-water reaction has been eliminated by reacting residual sodium with a purge flow of steam followed by a purge of nitrogen. Sampling of the purge gases verified that the reaction was complete and that all hydrogen evolved during the process had been purged from the system. After the final purge with nitrogen, the system was dry except for combined water associated with the sodium hydroxide residue left in the system. Radiolytic decomposition of water, owing to gamma ray emissions from the decay of activation products, would produce only a negligible quantity of hydrogen, in terms of the potential for creating a combustible mixture or building up a gas pressure, even if it is arbitrarily assumed that no diffusion of hydrogen occurred from the system.

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Radiological Safety of Stored Materials

As noted previously, radiation levels at all accessible points of the retired facility are approximately at background levels. Consequently, there would be no radiological hazard associated with allowing general public access to the site. Entry into the storage areas could pose a possible radiological hazard to the person(s) involved, unless such entry was accomplished with awareness that radioactive materials existed therein. Such entry would require deliberate extended effort, however, and it is exceedingly unlikely that it would be attempted.

To preclude the possibility that at some future date entry into the storage areas might be attempted under uncontrolled conditions, a description of the facility, its contents and a notice that entry into the facility requires permission of the appropriate governmental authority has been placed in the Deed for the property, thus becoming part of the permanent Lancaster County, Nebraska, land records. In addition, two sealed stainless steel capsules, containing a description of the contents of the facility and details of its construction, have been installed at the facility. One of these is located in a niche on the face of the IHX structure and the other at the center of the steel plate covering Storage Area No. 1. Engraved notices at each of these capsules warn that entry is prohibited unless appropriate authority has been obtained. We conclude that the foregoing measures are adequate to prevent uncontrolled entry into the Storage areas.

The only way in which the stored radioactive materials could conceivably reach the environment would be, through corrosion of the barriers surrounding the storage areas followed by corrosion of the materials containing the activation products and subsequent transport into the surrounding soil in water solution. In order to assess the possible consequences of such corrosion, an extremely conservative corrosion model was developed in which it was arbitrarily assumed that water invaded the facility five years after shutdown and promoted continuous general corrosion of the materials involved.

Taking into account the time rate of dissolution of the materials involved and the competing process of radioactive decay, the calculated maximum concentrations of the significant isotopes in water confined in the structure would be 1.3 times the allowable concentrations for water specified in 10 CFR 20 for Fe-55, 23 times allowable for Co-60 and 27 times allowable for Ni-63. Iron and cobalt activities come primarily

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from corrosion of carbon steel materials surrounding the reactor vessel, and the nickel activity concentration comes from the arbitrary assumptions that the stainless steel liner and thimbles of Area 2 have lost their integrity so that corrosion is initiated immediately. Should this confined water be released to the soil at the time the peak concentrations for each isotope exist, the ground water in immediate contact with the structure would exceed allowable concentrations. Considering the ion exchange capacity of the soil, however, these concentrations would be reduced several orders of magnitude in only a few meters of ground water travel. Thus, there would be negligible potential, even in this extreme case, for movement of significant amounts of activity into potable water supplies.

If this potential for corrosion of materials were considered more realistically, by assuming that water does not invade the facility until the 100-year design life of the structure is reached, radioactive decay would have reduced the Fe-55 activity to less than 4 microcuries and the Co-60 activity to less than 0.2 curies, most of which would be dispersed in corrosion resistant stainless steel components. About 5,900 curies of Ni-63 and 2,900 curies of Sm-151 would still be present, both dispersed in stainless steel. A potential hazard would still exist for direct handling of such materials; however, the potential for release by corrosion in significant quantities would be very slight. Analyses show that corrosion rates of the stainless steel barriers, e.g., the reactor vessel and the thimbles in storage Area No. 2, would take place at such slow rates that concentrations in water could not exceed the allowable level specified in 10 CFR 20 unless it were arbitrarily assumed that the vessel or the thimbles were breached early in the life of the structure so as to allow corrosion of the interior members and subsequent outleakage of contaminated water to occur. In such an event, the concentration of Ni-63 would be only slightly above permissible levels and the activity would be retained in soils adjacent to the structure. We conclude, therefore, that storage of activity at the Hallam site will not pose an undue risk to the health and safety of the public owing to contamination of ground water.

#### Surveillance

Although the potential for transport of radioactive materials stored in the isolation structure to the environment is insignificant, under the terms of its contract termination agreement with NPPD, the Commission nevertheless has made arrangements with the State of Nebraska Department of Health to conduct radiological surveillance semiannually to verify that



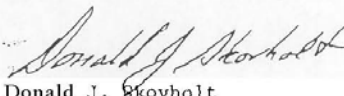
- 11 -

no radioactivity is being released. The results of surveillance conducted to date by the State verify that there has been no detectable release from the retired facility. Under the terms of the agreement with NPPD, the Commission will be responsible for instituting any remedial measures should activity be detected outside the facility and for making any necessary repairs to the structure to preserve its integrity should unanticipated damage or deterioration make this necessary. For these reasons, the Commission has retained the right of access to the facility.

CONCLUSION

Based on our review of the retirement activities performed, verification of an adequate degree of compliance with the criteria specified for securing the facility, and assessment of the present and future radiological status of the retired facility and its environs, we conclude:

1. that the facility and the site have been placed in a safe condition that will permit unlimited access to the site without danger of exposure of individuals to radiation levels significantly above background;
2. that the manner in which radioactive materials are stored will preclude transport of radionuclides into ground water in any significant amount;
3. that adequate control provisions have been made to prevent unauthorized access to storage areas within the retired facility; and
4. that the existence of stored radioactive material at the Hallam Nuclear Power Facility is not inimical to the common defense and security or to the health and safety of the public.

  
Donald J. Skovholt  
Assistant Director for  
Reactor Operations  
Division of Reactor Licensing

Date: July 20, 1971

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## **Appendix C**

### **Correspondence Between DOE and Nebraska Department of Health and Human Services**

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NEBRASKA HEALTH AND HUMAN SERVICES SYSTEM



DEPARTMENT OF SERVICES • DEPARTMENT OF REGULATION AND LICENSURE  
DEPARTMENT OF FINANCE AND SUPPORT

STATE OF NEBRASKA  
DAVE HEINEMAN, GOVERNOR

February 2, 2007

Department of Energy  
Office of Legacy management  
19901 Germantown Road  
Germantown, ND 20874

Subject: USDOE Recommends Discontinuing Monitoring at the Hallam Nuclear Power Facility (HNPF), Hallam, Nebraska.

Dear Ms. Powell, Site Manager

This office has reviewed your letter and the submitted report no. DOE-LLM/1319-206 dated September 26, 2006. The Department does not concur with your recommendation. The Department recommends reducing the sampling and analysis frequency to once every two years.

Abnormally dry to severe drought conditions have existed during most of the monitoring of the HNPF. The report neither mentions the drought of 2000 through the present nor discusses its effects on the ground water monitoring and the applicability of the monitoring to years with normal or above normal precipitation.

From your report, nickel-63 and samarium-151 remain of significant activity levels. The two nuclides have half-lives at 100 years and 90 years respectively. As stated in your report, DOE can not release the decommissioned reactor for unrestricted use for about 100 years after decommissioning, and should be committed to continue periodic monitoring during that time period.

We would encourage a follow up discussion with you and Nebraska Public Power District on this matter. I may be reached at (402) 471-0171 or E-mail at [jim.defrain@hhss.ne.gov](mailto:jim.defrain@hhss.ne.gov).

Sincerely,

Jim DeFrain, Health Physicist  
Radiation Control Program

Cc: Russ Neffeler, Environmental Compliance Auditor, Nebraska Public Power District  
Marty Link, Associate Program Director, Nebraska Department of Environmental Quality

DEPARTMENT OF HEALTH AND HUMAN SERVICES REGULATION AND LICENSURE  
PO Box 95007, LINCOLN, NE 68509-5007 PHONE (402) 471-2133  
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Department of Energy  
Office of Legacy Management

March 14, 2007

Mr. Jim DeFrain  
Department of Health and Human Services  
Regulations and Licensure  
P.O. Box 95007  
Lincoln, NE 68509-5007

Subject: USDOE Recommends Discontinuing Monitoring at the Hallam Nuclear Power Facility (HNPF), Hallam, Nebraska

Dear Mr. DeFrain:

In response to your letter dated February 2, 2007, the U.S. Department of Energy (DOE) Office of Legacy Management is pleased that the State of Nebraska would endorse a biennial monitoring frequency at the decommissioned Hallam Nuclear Power Facility. As documented in our September 2006 report, there have been no impacts on shallow perched ground water in the immediate vicinity of the entombed reactor. Assuming that future monitoring results continue to demonstrate no impact, we would expect that continued reductions in monitoring frequency and possibly monitoring points would be justified, and these could ultimately lead to an abandonment of ground water monitoring altogether. However, in the near-term we expect that the next two ground water monitoring events would be in June 2008 and June 2010.

In reference to your letter, we did not mention the drought conditions you describe because the ground water levels in the shallow wells have not changed appreciably since the wells were installed. Based on an examination of precipitation data (1948 – 2006) for the neighboring towns of Crete, Hickman, and Beatrice, we recognize that the past six years may have been drier than normal; however, the wells were installed during a period of above normal precipitation. The hydrographs presented in our report show that shallow ground water levels, and concentrations of dissolved chemical constituents, remained relatively constant between 1998 and 2006.

You also referred to the nickel-63 and samarium-151, which remained in the reactor cavity after the power plant was decommissioned. Notwithstanding that nickel-63 was never detected in ground water monitoring at the site, we propose to continue analyzing the ground water samples for nickel-63 and to continue the gamma spectrometry scans that target 19 additional analytes. We also propose to continue monitoring for tritium because greatly elevated activities of tritium

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3610 Collins Ferry Road, P.O. Box 880, Morgantown, WV 26507	626 Cochran's Mill Road, P.O. Box 10940, Pittsburgh, PA 15236
1000 Independence Ave., S.W., Washington, DC 20585	12101 Airport Way, Unit C, Broomfield, CO 80021-2583
11003 Hamilton-Cleves Hwy., Harrison, OH 45030	X
232 Energy Way, N. Las Vegas, NV 89030	955 Mound Road, Miamisburg, OH
	7295 Hwy 94 South, St. Charles, MO 63304

Mr. Jim DeFrain  
March 14, 2007

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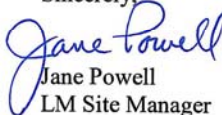
could be an indicator of a failure in the decommissioned reactor core. However, in future monitoring we may consider dropping gross alpha from the list of analytes because it is normally an indicator of radium (and uranium) decay and may occur naturally in the glacial till.

During the April 2006 inspection, and previous inspections of the Hallam site, it was noted that some of the DOE wells are in or along traffic patterns established by operators of the Sheldon Power Station. In particular, it is a matter of time before plant operators collide with well pair OBS 2B and 2C; therefore, DOE plans to reconfigure these two wells, and potentially other wells at the site, into flush mounted completions.

I may be reached at either 513-648-3148 or via email at [jane.powell@lm.doe.gov](mailto:jane.powell@lm.doe.gov)

We would welcome a discussion with you concerning these topics and other topics of mutual interest. I will be contacting you shortly regarding a suitable time to begin that discussion.

Sincerely,

  
Jane Powell  
LM Site Manager

JP/dp

c:  
Robert Ransbottom, Stoller (e)  
Project Files (Thru D. Roberts)

End of current text